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PROPERTIES OF THE INITIAL COMPONENTS

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One of the important characteristics of the quality of commercial diesel fuels is their pour point, determined according to All-Union State Standard 1533-42.

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Diesel fuels are prepared by the method of blending of individual hydrocarbon fractions. In addition, with the storage of diesel fuels in bulk plants, the necessity often occurs of reducing their pour point by means of the addition of a lighter petroleum product.

In this and other cases, in order to determine the relationship of the initial products in order to produce a diesel fuel with the required pour point, it is necessary to know the dependence of the pour point of the mixture on the properties and relationship of the initial components.

In practice, in order to select a formula prior to each blending, it is necessary to resort to the preparation of a number of control mixtures, which requires large time expenditures.

In order to find the analytic dependence which would make it possible to determine the pour point of diesel fuels, according to the pour points and per cent relationship of the initial components, without carrying out laboratory analyses, we determined the pour points of mixtures prepared from products with different pour points in different weight relationships.

*Numbers in the margin indicate pagination in the foreign text.

The properties of the initial components, from which the mixtures were prepared, are given in table 1.

TABLE 1
CHARACTERISTICS OF INITIAL COMPONENTS

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a Компоненты		b Температура застывания (по ГОСТ 1533-42), °C
c	Фракция прямой гонки	От -10 до -13
d	Вакуумный погон	От +11 до +14
e	Фракция гидроочистки	От -8 до -12
f	Фракция каталитического крекинга	От -5 до -10
g	Продукт А	-50

Key: a. Components
b. Pour point (according to All-Union State Standard 1533-42), °C
c. Fraction of direct distillation
d. Vacuum distillate
e. Fraction of hydro-refining
f. Fraction of catalytic cracking
g. Product A
h. From...to

Mathematical processing of the experimental data made it possible to obtain the analytic expression of the dependence of the pour point of diesel fuels on the pour point and per cent relationship of the initial components.

$$t = t_1 + (t_2 - t_1) (0,66x + 0,34x), \quad (1)$$

where t is the pour point of the mixture, in °C; t_1 is the highest of the pour points of the two blended components, in °C; t_2 is the lowest of the pour points of the two blended components, in °C; x is the weight portion of the component in the mixture which has the lower pour point.

In order to determine the pour point of a multicomponent mixture, having calculated the pour point of the mixture of the first and second components, it is necessary to use this

latter pour point as the pour point of a separate equivalent component, and to further calculate the pour point of a mixture of the equivalent component and a third component, and so on.

Compared in table 2 are the values of the pour points of diesel fuels, calculated according to formula (1) and determined by laboratory analyses according to All-Union State Standard 1533-42.

TABLE 2
COMPARISON OF VALUES OF THE POUR POINTS OF DIESEL FUELS,
CALCULATED ANALYTICALLY AND DETERMINED ACCORDING TO
ALL-UNION STATE STANDARD 1533-42

a Смесь	b Температура застывания компонентов, °C		e Содержание в смеси компонента с более низкой температурой застывания в долях единицы	f Температура застывания смеси, °C		i Разница между температурами застывания, рассчитанными по формуле (1) и определенными по ГОСТ 1533-42, °C
	c первого	d второго		g рассчитанная по формуле (1)	h определенная по ГОСТ 1533-42	
1	13	-10	0,4	6,7	7	-0,3
2	13	-10	0,6	1,5	2	-0,5
3	13	-10	0,8	-5	-4	-1
4	-1	-12	0,2	-2	-2	0
5	-1	-12	0,5	-4,7	-5	0,3
6	-1	-12	0,8	-8,65	-9	0,35
7	14	-50	0,02	13,5	12	1,5
8	14	-50	0,3	4,2	6	-1,8

Key: a. Mixture
b. Pour point of components, °C
c. first
d. second
e. Content in mixture of component with lower pour point, in parts of unit
f. Pour point of mixture, °C
g. calculated according to formula (1)
h. determined according to All-Union State Standard 1533-42
i. Difference between pour points calculated according to formula (1) and determined according to All-Union State Standard 1533-42, °C

Example. We will determine the pour point of the diesel fuel produced by blending 10%, by weight, of component 1, with

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a pour point of $+14^{\circ}\text{C}$, 20% of component 2, with a pour point of -50°C , and 70% of component 3, with a pour point of -13°C .

1. Components 1 and 2 are examined. The equivalent content of the component with a lower pour point is determined in a mixture of these two components (this is component 2 in the given case):

$$x_{21} = \frac{x_2}{x_1 + x_2}, \quad (2)$$

where x_{21} is the equivalent content of component 2 in the mixture, in parts of a unit; x_2 is the content of component 2 in the mixture in parts of a unit; x_1 is the content of component 1 in the mixture, in parts of a unit.

$$x_{21} = \frac{0.2}{0.1 + 0.2} = 0.67.$$

2. Determined according to formula (1) is the pour point which is equivalent to the pour point of the mixture consisting of components 1 and 2.

$$t = 14 + [(-50) - (-14)] (0.66 \cdot 0.67 + 0.34 \cdot 0.67) = -19.5^{\circ}\text{C}.$$

3. Determined according to formula (1) is the pour point of the equivalent and third components, i.e., the pour point of the prepared mixture

$$t = -13 + [(-19.5) - (-13)] (0.66 \cdot 0.3 + 0.34 \cdot 0.3) = -14^{\circ}\text{C}.$$

The pour point of such a mixture, determined by laboratory analysis according to All-Union State Standard 1533-42, is equal to -13°C .

Conclusions

A formula is obtained which makes it possible, without conducting laboratory analyses, to sufficiently accurately determine the pour point of diesel fuels, according to the pour points and percent weight relationship of the initial components.

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